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**west virginia** department of environmental protection

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Office of Oil and Gas  
601 57th Street SE  
Charleston, WV 25304  
(304) 926-0450  
(304) 926-0452 fax

Earl Ray Tomblin, Governor  
Randy C. Huffman, Cabinet Secretary  
[www.dep.wv.gov](http://www.dep.wv.gov)

January 22, 2014

**WELL WORK PERMIT**

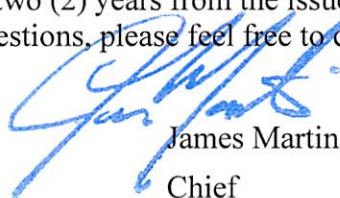
**Horizontal 6A Well**

This permit, API Well Number: 47-1706435, issued to ANTERO RESOURCES CORPORATION, is evidence of permission granted to perform the specified well work at the location described on the attached pages and located on the attached plat, subject to the provisions of Chapter 22 of the West Virginia Code of 1931, as amended, and all rules and regulations promulgated thereunder, and to all conditions and provisions outlined in the pages attached hereto. Notification shall be given by the operator to the Oil and Gas Inspector at least 24 hours prior to the construction of roads, locations, and/or pits for any permitted work. In addition, the well operator shall notify the same inspector 24 hours before any actual well work is commenced and prior to running and cementing casing. Spills or emergency discharges must be promptly reported by the operator to 1-800-642-3074 and to the Oil and Gas inspector.

Please be advised that form WR-35, Well Operators Report of Well Work is to be submitted to this office within 90 days completion of permitted well work, as should form WR-34 Discharge Monitoring Report within 30 days of discharge of pits, if applicable. Failure to abide by all statutory and regulatory provisions governing all duties and operations hereunder may result in suspension or revocation of this permit and, in addition, may result in civil and/or criminal penalties being imposed upon the operators.

In addition to the applicable requirements of this permit, and the statutes and rules governing oil and gas activity in WV, this permit may contain specific conditions which must be followed. Permit conditions are attached to this cover letter.

Per 35CSR-4-5.2.g this permit will expire in two (2) years from the issue date unless permitted well work is commenced. If there are any questions, please feel free to contact me at (304) 926-0499 ext. 1654.



James Martin  
Chief

Operator's Well No: LETTIE UNIT 2H  
Farm Name: PERINE, JUNIOR

**API Well Number: 47-1706435**

**Permit Type: Horizontal 6A Well**

Date Issued: 01/22/2014

**Promoting a healthy environment.**

## PERMIT CONDITIONS

West Virginia Code § 22-6A-8(d) allows the Office of Oil and Gas to place specific conditions upon this permit. Permit conditions have the same effect as law. Failure to adhere to the specified permit conditions may result in enforcement action.

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### CONDITIONS

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1. This proposed activity may require permit coverage from the United States Army Corps of Engineers (USACOE). Through this permit, you are hereby being advised to consult with USACOE regarding this proposed activity.
2. If the operator encounters an unanticipated void, or an anticipated void at an unanticipated depth, the operator shall notify the inspector within 24 hours. Modifications to the casing program may be necessary to comply with W. Va. Code § 22-6A-5a (12), which requires drilling to a minimum depth of thirty feet below the bottom of the void, and installing a minimum of twenty (20) feet of casing. Under no circumstance should the operator drill more than fifty (50) feet below the bottom of the void or install less than twenty (20) feet of casing below the bottom of the void.
3. When compacting fills, each lift before compaction shall not be more than 12 inches in height, and the fill material shall be within plus or minus 2% of the optimum moisture content as determined by the standard proctor density test, ASTM D698, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort. Each lift must meet 95 % compaction of the optimum density based on results from the standard proctor density test of the actual soils used in specific engineered fill sites. Each lift shall be tested for compaction, with a minimum of two tests per lift per acre of fill. All test results shall be maintained on site and available for review.
4. Operator shall install signage per § 22-6A-8g (6) (B) at all source water locations included in their approved water management plan within 24 hours of water management plan activation.
5. Oil and gas water supply wells will be registered with the Office of Oil and Gas and all such wells will be constructed and plugged in accordance with the standards of the Bureau for Public Health set forth in its Legislative rule entitled *Water Well Regulations*, 64 C.S.R. 19. Operator is to contact the Bureau of Public Health regarding permit requirements. In lieu of plugging, the operator may transfer the well to the surface owner upon agreement of the parties. All drinking water wells within fifteen hundred feet of the water supply well shall be flow tested by the operator upon request of the drinking well owner prior to operating the water supply well.
6. Pursuant to the requirements pertaining to the sampling of domestic water supply wells/springs the operator shall, no later than thirty (30) days after receipt of analytical data provide a written copy to the Chief and any of the users who may have requested such analyses.
7. If any explosion or other accident causing loss of life or serious personal injury occurs in or about a well or well work on a well, the well operator or its contractor shall give notice, stating the particulars of the explosion or accident, to the oil and gas inspector and the Chief, within 24 hours of said accident.
8. During the casing and cementing process, in the event cement does not return to the surface, the oil and gas inspector shall be notified within 24 hours.

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STATE OF WEST VIRGINIA  
DEPARTMENT OF ENVIRONMENTAL PROTECTION, OFFICE OF OIL AND GAS  
WELL WORK PERMIT APPLICATION

- 1) Well Operator: Antero Resources Corporation 494488557 017-Doddridge Greenbrier Big Isaac 7.5'  
Operator ID County District Quadrangle
- 2) Operator's Well Number: Lettie Unit 2H Well Pad Name: Wagner Pad (existing)
- 3) Farm Name/Surface Owner: Junior Perine Public Road Access: CR 44
- 4) Elevation, current ground: 1270' Elevation, proposed post-construction: 1270'
- 5) Well Type (a) Gas ☒ Oil ☐ Underground Storage ☐  
Other ☐  
(b) If Gas Shallow ☒ Deep ☐  
Horizontal ☒
- 6) Existing Pad: Yes or No Yes
- 7) Proposed Target Formation(s), Depth(s), Anticipated Thickness and Associated Pressure(s):  
Marcellus Shale: 7400' TVD, Anticipated Thickness- 60 Feet, Associated Pressure- 3250#
- 8) Proposed Total Vertical Depth: 7400' TVD
- 9) Formation at Total Vertical Depth: Marcellus Shale
- 10) Proposed Total Measured Depth: 18,300' MD
- 11) Proposed Horizontal Leg Length: 10,557'
- 12) Approximate Fresh Water Strata Depths: 176', 208', 334'
- 13) Method to Determine Fresh Water Depths: Offset well records. Depths have been adjusted according to surface elevations.
- 14) Approximate Saltwater Depths: 575', 1797', 1946'
- 15) Approximate Coal Seam Depths: 328', 648', 1376'
- 16) Approximate Depth to Possible Void (coal mine, karst, other): None anticipated
- 17) Does Proposed well location contain coal seams directly overlying or adjacent to an active mine? Yes ☐ No ☒
- (a) If Yes, provide Mine Info: Name: \_\_\_\_\_  
Depth: \_\_\_\_\_  
Seam: \_\_\_\_\_  
Owner: \_\_\_\_\_

DCW  
1-9-2014  
MAC

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WW-6B  
(9/13)

4717006435

18)

**CASING AND TUBING PROGRAM**

TYPE	Size	New or Used	Grade	Weight per ft. (lb/ft)	FOOTAGE: For Drilling	INTERVALS: Left in Well	CEMENT: Fill-up (Cu. Ft.)
Conductor	20"	New	H-40	94#	40'	40'	CTS, 38 Cu. Ft.
Fresh Water	13-3/8"	New	J-55/H-40	54.5#/ 48#	400'	400' *see #19	CTS, 556 Cu. Ft.
Coal	9-5/8"	New	J-55	36#	2460'	2460'	CTS, 1002 Cu. Ft.
Intermediate							
Production	5-1/2"	New	P-110	20#	18300'	18300'	4637 Cu. Ft.
Tubing	2-3/8"	New	N-80	4.7#		7100'	
Liners							

DCN  
1-9-2014  
MDG

TYPE	Size	Wellbore Diameter	Wall Thickness	Burst Pressure	Cement Type	Cement Yield (cu. ft./k)
Conductor	20"	24"	0.438"	1530	Class A	1.18
Fresh Water	13-3/8"	17-1/2"	0.38"/0.33"	2730/1730	Class A	1.18
Coal	9-5/8"	12-1/4"	0.352"	3520	Class A	1.18
Intermediate						
Production	5-1/2"	8-3/4" & 8-1/2"	0.361"	12630	Lead-H/POZ & Tail - H	H/POZ-1.44 & H-1.8
Tubing	2-3/8"	4.778"	0.19"	11200		
Liners						

**PACKERS**

Kind:	N/A			
Sizes:	N/A			
Depths Set:	N/A			

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19) Describe proposed well work, including the drilling and plugging back of any pilot hole:

Drill, perforate, fracture a new horizontal shallow well and complete Marcellus Shale.

\*Antero will be air drilling the fresh water string which makes it difficult to determine when freshwater is encountered, therefore we have built in a buffer for the casing setting depth which helps to ensure that all fresh water zones are covered.

20) Describe fracturing/stimulating methods in detail, including anticipated max pressure and max rate:

Antero plans to pump Slickwater into the Marcellus Shale formation in order to ready the well for production. The fluid will be comprised of approximately 99 percent water and sand, with less than 1 percent special-purpose additives as shown in the attached "List of Anticipated Additives Used for Fracturing or Stimulating Well."

21) Total Area to be disturbed, including roads, stockpile area, pits, etc., (acres): 14.27 acres (existing)

22) Area to be disturbed for well pad only, less access road (acres): 4.03 acres (existing)

23) Describe centralizer placement for each casing string:

Conductor: no centralizers

Surface Casing: one centralizer 10' above the float shoe, one on the insert float collar and one every 4th joint spaced up the hole to surface.

Intermediate Casing: one centralizer above float joint, one centralizer 5' above float collar and one every 4th collar to surface.

Production Casing: one centralizer at shoe joint and one every 3 joints to top of cement in intermediate casing.

24) Describe all cement additives associated with each cement type:

Conductor: no additives, Class A cement.

Surface: Class A cement with 2-3% calcium chloride

Intermediate: Class A cement with 1/4 lb of flake, 5 gallons of clay treat

Production: Lead cement- 50/50 Class H/Poz + 1.5% salt + 1% C-45 + 0.5% C-16a + 0.2% C-12 + 0.45% C-20 + 0.05% C-51

Production: Tail cement- Class H + 45 PPS Calcium Carbonate + 1.0% FL-160 + 0.2% ACGB-47 + 0.05% ACSA-51 + 0.2% ACR-20

25) Proposed borehole conditioning procedures:

Conductor: blowhole clean with air, run casing, 10 bbls fresh water.

Surface: blowhole clean with air, trip to conductor shoe, trip to bottom, blowhole clean with air, trip out, run casing, circulate pipe capacity + 40 bbls fresh water followed by 25 bbls bentonite mud, 10 bbls fresh water spacer.

Intermediate: blowhole clean with air, trip to surface casing shoe, trip to bottom, blowhole clean with air, trip out, run casing, circulate 40 bbls brine water followed by 10 bbls fresh water and 25 bbls bentonite mud, pump 10 bbls fresh water.

Production: circulate with 14 lb/gal NaCl mud, trip to middle of lateral, circulate, pump high viscosity sweep, trip to base of curve, pump high viscosity sweep, trip to top of curve, trip to bottom, circulate, pump high viscosity sweep, trip out, run casing, circulate 10 bbls fresh water, pump 48 bbls barite pill, pump 10 bbls fresh water followed by 48 bbls mud flush and 10 bbls water.

Office of Oil and Gas

\*Note: Attach additional sheets as needed.

JAN 10 2014

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WW-9  
(9/13)API Number 47 - 017 -  
Operator's Well No. Lettie Unit 2HSTATE OF WEST VIRGINIA  
DEPARTMENT OF ENVIRONMENTAL PROTECTION  
OFFICE OF OIL AND GAS

## FLUIDS/ CUTTINGS DISPOSAL &amp; RECLAMATION PLAN

Operator Name Antero Resources Corporation OP Code 494488557Watershed (HUC 10) Tributary of Johnson Fork Quadrangle Big Isaac 7.5'Elevation 1270' County Doddridge District GreenbrierDo you anticipate using more than 5,000 bbls of water to complete the proposed well work? Yes ☒ No ☐Will a pit be used? Yes ☐ No ☒If so, please describe anticipated pit waste: No pit will be used at this site (Drilling and Flowback Fluids will be stored in tanks. Cuttings will be tanked and hauled off site.)Will a synthetic liner be used in the pit? Yes ☐ No ☒ If so, what ml.? N/A

Proposed Disposal Method For Treated Pit Wastes:

- ☐ Land Application
- ☐ Underground Injection ( UIC Permit Number \_\_\_\_\_ )
- ☒ Reuse (at API Number \_\_\_\_\_ Future permitted well locations when applicable. API# will be provided on Form WR-34)
- ☒ Off Site Disposal (Supply form WW-9 for disposal location) (Meadowfill Landfill Permit #SWF-1032-98)
- ☐ Other (Explain \_\_\_\_\_)

DCW  
1-9-2014  
MDGWill closed loop system be used? If so, describe: YesDrilling medium anticipated for this well (vertical and horizontal)? Air, freshwater, oil based, etc. Surface - Air/Freshwater, Intermediate - Dust/Stiff Foam, Production - Water Based Mud-If oil based, what type? Synthetic, petroleum, etc. N/AAdditives to be used in drilling medium? Please See AttachmentDrill cuttings disposal method? Leave in pit, landfill, removed offsite, etc. Stored in tanks, removed offsite and taken to landfill.-If left in pit and plan to solidify what medium will be used? (cement, lime, sawdust) N/A-Landfill or offsite name/permit number? Meadowfill Landfill (Permit #SWF-1032-98)

I certify that I understand and agree to the terms and conditions of the GENERAL WATER POLLUTION PERMIT issued on August 1, 2005, by the Office of Oil and Gas of the West Virginia Department of Environmental Protection. I understand that the provisions of the permit are enforceable by law. Violations of any term or condition of the general permit and/or other applicable law or regulation can lead to enforcement action.

I certify under penalty of law that I have personally examined and am familiar with the information submitted on this application form and all attachments thereto and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment.

Company Official Signature [Signature]Company Official (Typed Name) Gerard G. AlbertsCompany Official Title Environmental & Regulatory ManagerRECEIVED  
Office of Oil and GasSubscribed and sworn before me this Dec day of 19

NOV 13 2014  
LISA BOTTINELLI  
Notary Public  
State of Colorado  
Notary ID 20124072365  
My Commission Expires Nov 9, 2016

My commission expires 11/9/2016

Environmental Protection

4717006435

Form WW-9

Operator's Well No. Lettie Unit 2HAntero Resources CorporationProposed Revegetation Treatment: Acres Disturbed 14.27 Prevegetation pH \_\_\_\_\_Lime 2-4 Tons/acre or to correct to pH 6.5Fertilizer type Hay or straw or Wood Fiber (will be used where needed)Fertilizer amount 500 lbs/acreMulch 2-3 Tons/acreExisting Road A (1.79) + Existing Road B (0.42) + Existing Tank Pad (4.69) + Existing Drill Pad (4.03) + Existing Parking Areas (1.81) + Spoil Pad C (1.53) = 14.27 Existing AcresSeed MixturesTemporaryPermanent

Seed Type	lbs/acre
Tall Fescue	45
Perennial Rye Grass	20
*or type of grass seed requested by surface owner	

Seed Type	lbs/acre
Tall Fescue	45
Perennial Rye Grass	20
*or type of grass seed requested by surface owner	

## Attach:

Drawing(s) of road, location, pit and proposed area for land application (unless engineered plans including this info have been provided)

Photocopied section of involved 7.5' topographic sheet.

Plan Approved by: Douglas Newlon Michael DoffComments: seed + mulch any disturbed areas maintain  
ETSContact inspector before conductor setTitle: Oil & Gas InspectorDate: 1-9-2014

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Field Reviewed?

☐ Yes☒ No

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flat spotted



PETRA 2/11/2013 3:22:22 PM

Antero Resources Corporation

Appalachian Basin

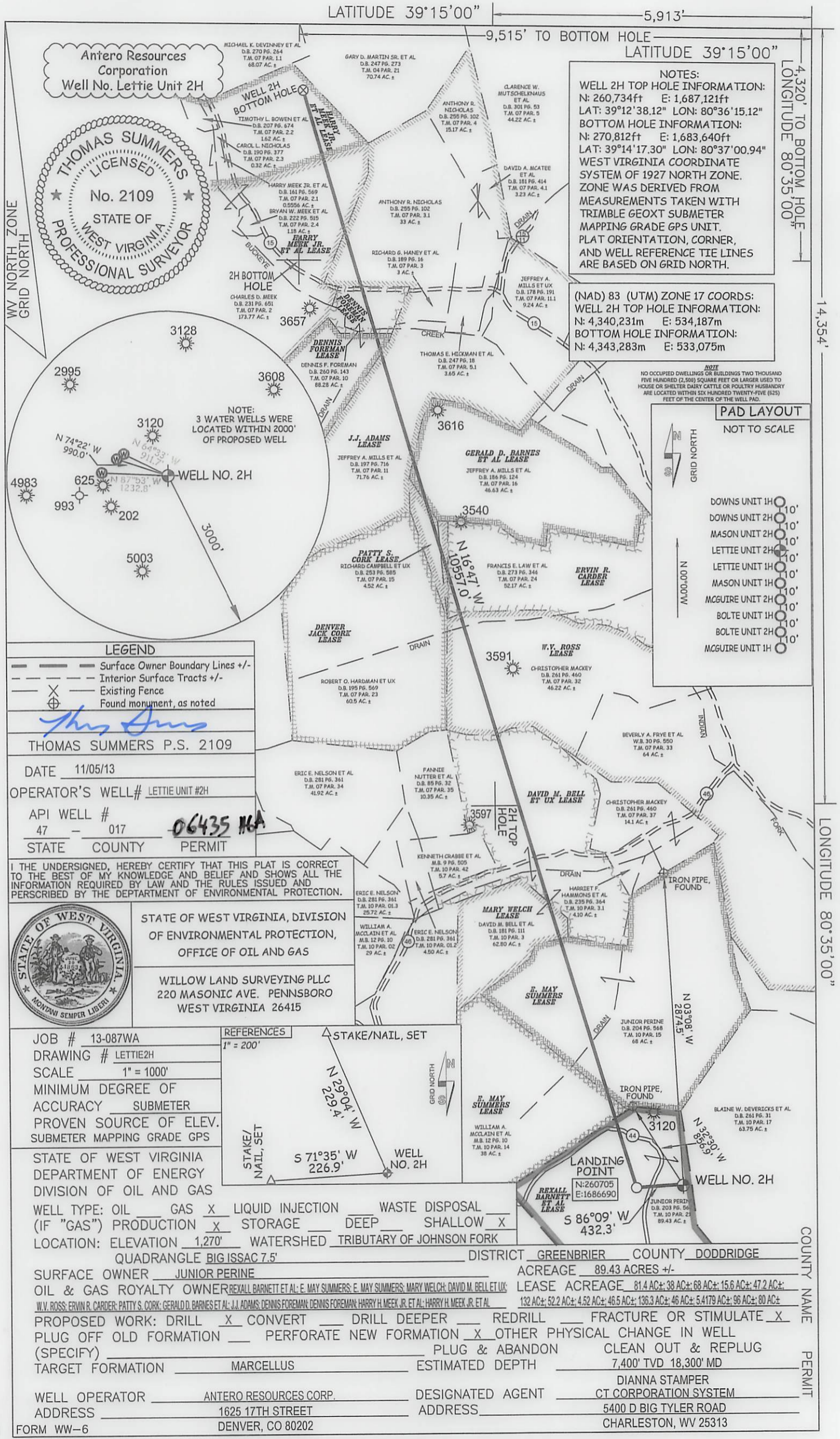
Lettie Unit 2H

Doddridge County

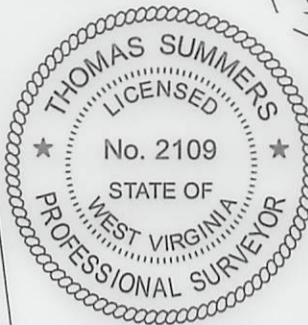


REMARKS  
QUADRANGLE: BIG ISAAC  
WATERSHED: MIDDLE ISLAND CREEK  
DISTRICT: GREENBRIER

February 11, 2013



Antero Resources Corporation  
Well No. Lettie Unit 2H



WV NORTH ZONE  
GRID NORTH

LATITUDE 39°15'00"

9,515' TO BOTTOM HOLE

5,913'

LATITUDE 39°15'00"

4,320' TO BOTTOM HOLE  
LONGITUDE 80°35'00"

14,354'

NOTES:  
WELL 2H TOP HOLE INFORMATION:  
N: 260,734ft E: 1,687,121ft  
LAT: 39°12'38.12" LON: 80°36'15.12"  
BOTTOM HOLE INFORMATION:  
N: 270,812ft E: 1,683,640ft  
LAT: 39°14'17.30" LON: 80°37'00.94"  
WEST VIRGINIA COORDINATE  
SYSTEM OF 1927 NORTH ZONE.  
ZONE WAS DERIVED FROM  
MEASUREMENTS TAKEN WITH  
TRIMBLE GEOXT SUBMETER  
MAPPING GRADE GPS UNIT.  
PLAT ORIENTATION, CORNER,  
AND WELL REFERENCE TIE LINES  
ARE BASED ON GRID NORTH.

(NAD) 83 (UTM) ZONE 17 COORDS:  
WELL 2H TOP HOLE INFORMATION:  
N: 4,340,231m E: 534,187m  
BOTTOM HOLE INFORMATION:  
N: 4,343,283m E: 533,075m

NOTE  
NO OCCUPIED DWELLINGS OR BUILDINGS TWO THOUSAND  
FIVE HUNDRED (2,500) SQUARE FEET OR LARGER USED TO  
HOUSE OR SHELTER DAIRY CATTLE OR POULTRY HUSBANDRY  
ARE LOCATED WITHIN SIX HUNDRED TWENTY-FIVE (625)  
FEET OF THE CENTER OF THE WELL PAD.

PAD LAYOUT  
NOT TO SCALE



- 10' DOWN'S UNIT 1H
- 10' DOWN'S UNIT 2H
- 10' MASON UNIT 2H
- 10' LETTIE UNIT 2H
- 10' LETTIE UNIT 1H
- 10' MASON UNIT 1H
- 10' MCGUIRE UNIT 2H
- 10' BOLTE UNIT 1H
- 10' BOLTE UNIT 2H
- 10' MCGUIRE UNIT 1H

LEGEND

- Surface Owner Boundary Lines +/-
- Interior Surface Tracts +/-
- Existing Fence
- Found monument, as noted

THOMAS SUMMERS P.S. 2109

DATE 11/05/13

OPERATOR'S WELL# LETTIE UNIT #2H

API WELL #

47 - 017

STATE COUNTY PERMIT

06435 MA

I THE UNDERSIGNED, HEREBY CERTIFY THAT THIS PLAT IS CORRECT  
TO THE BEST OF MY KNOWLEDGE AND BELIEF AND SHOWS ALL THE  
INFORMATION REQUIRED BY LAW AND THE RULES ISSUED AND  
PERSCRIBED BY THE DEPARTMENT OF ENVIRONMENTAL PROTECTION.



STATE OF WEST VIRGINIA, DIVISION  
OF ENVIRONMENTAL PROTECTION,  
OFFICE OF OIL AND GAS

WILLOW LAND SURVEYING PLLC  
220 MASONIC AVE. PENNSBORO  
WEST VIRGINIA 26415

JOB # 13-087WA

DRAWING # LETTIE2H

SCALE 1" = 1000'

MINIMUM DEGREE OF

ACCURACY SUBMETER

PROVEN SOURCE OF ELEV.

SUBMETER MAPPING GRADE GPS

STATE OF WEST VIRGINIA  
DEPARTMENT OF ENERGY  
DIVISION OF OIL AND GAS

WELL TYPE: OIL GAS ☒ LIQUID INJECTION WASTE DISPOSAL  
(IF "GAS") PRODUCTION ☒ STORAGE DEEP SHALLOW ☒  
LOCATION: ELEVATION 1,270' WATERSHED TRIBUTARY OF JOHNSON FORK

QUADRANGLE BIG ISSAC 7.5'

DISTRICT GREENBRIER COUNTY DODDRIDGE

SURFACE OWNER JUNIOR PERINE

ACREAGE 89.43 ACRES +/-

OIL & GAS ROYALTY OWNER REXALL BARNETT ET AL; E. MAY SUMMERS; E. MAY SUMMERS; MARY WELCH; DAVID M. BELL ET UX;

LEASE ACREAGE 81.4 AC; 38 AC; 68 AC; 15.6 AC; 47.2 AC;

W.V. ROSS; ERVIN R. CORDER; PATTY S. CORK; GERALD D. BARNES ET AL; J.J. ADAMS; DENNIS FOREMAN; HARRY H. MEER, JR. ET AL; HARRY H. MEER, JR. ET AL

132 AC; 52.2 AC; 4.52 AC; 46.5 AC; 136.3 AC; 46 AC; 5,417.9 AC; 96 AC; 80 AC;

PROPOSED WORK: DRILL ☒ CONVERT ☐ DRILL DEEPER ☐ REDRILL ☐ FRACTURE OR STIMULATE ☒

PLUG OFF OLD FORMATION ☐ PERFORATE NEW FORMATION ☒ OTHER PHYSICAL CHANGE IN WELL

(SPECIFY) PLUG & ABANDON CLEAN OUT & REPLUG

TARGET FORMATION MARCELLUS ESTIMATED DEPTH 7,400' TVD 18,300' MD

WELL OPERATOR ANTERO RESOURCES CORP. DESIGNATED AGENT DIANNA STAMPER

ADDRESS 1625 17TH STREET ADDRESS 5400 D BIG TYLER ROAD

DENVER, CO 80202 CHARLESTON, WV 25313

FORM WW-6